

Risk Management



Jack Harrison

Demand for Yield & Revenue Insurance: Factoring In Risk, Income & Cost

Rapid expansion has occurred in the number of federally backed insurance products offered to farmers since the 1996 farm legislation. Although federally subsidized insurance has been a part of the government's farm program for over a half century—yield-based insurance was available as early as 1938 for selected crops in selected locations—crop insurance was not widely accepted by farmers until recently. Prior to 1996, commodity programs shielded agriculture from some of the risks stemming from weather and markets, lessening the need for crop insurance. Some researchers also cite the frequent use of Federal ad hoc disaster assistance payments as a disincentive to purchasing crop insurance (*AO* August 1999).

However, the demand for crop insurance increased in the last few years due to higher Federal insurance premium subsidies, as well as the introduction of several new revenue insurance products that increase farmers' choices and that some

operators find more attractive than crop-yield insurance alone. The array of insurance products currently available to producers is growing, and their use as a risk management tool is widening.

In Iowa, for example, three revenue insurance products—Crop Revenue Coverage (CRC), Income Protection (IP), and Revenue Assurance (RA)—were first offered in 1996-97. Also available were the more traditional yield-based products—Multiple Peril Crop Insurance (MPCI), which includes a minimum catastrophic coverage (CAT), and the Group Risk Plan (GRP). (See page 18 for descriptions of insurance products.) After just 3 years, acreage covered under the revenue insurance products accounts for more than half of insured acres for corn and soybeans in Iowa.

In 1999, revenue insurance choices for U.S. farmers continue to expand with the introduction of two new products. Group Risk Income Protection (GRIP) adds a revenue component to GRP area-yield insurance, and Adjusted Gross Revenue (AGR) offers coverage on a whole-farm rather than crop-by-crop basis (*AO* May 1999).

At issue with regard to farmers' participation in insurance markets are a number of questions. What factors are driving farmers toward these new risk management tools? How do farmers decide among different insurance products? Can the increase in farmers' demand for insurance, especially for the new revenue insurance products, be sustained? Addressing such questions can be a key step in anticipating the demand for yield and revenue insurance products and the potential for growth in a more market-oriented policy environment.

USDA's Economic Research Service (ERS) has examined the demand for yield and revenue insurance products among corn and soybean producers who purchased insurance in Iowa, where a range of insurance products was offered to farmers in 1997. Using 1997 data collected by USDA's Risk Management Agency (RMA), the study analyzed the role of farmers' risk characteristics, farm income level, and the cost of insurance in making decisions on insurance purchases. This is the first attempt to analyze farmers' demand for crop and revenue insurance in the post-1996 Farm Act policy environment, in which farmers are offered multiple insurance products.

The Risk Management Agency maintains records of all individual farmers who buy federally backed crop-yield or revenue insurance from private insurance companies. About 80,000 insurance records contain 10 years of yield history and

About the Demand Model

A Generalized Polytomous Logit (GPL) model is specified and estimated to accommodate the demand for crop insurance where the choice of an insurance product is *discrete*—i.e., farmers make a choice of one distinct product from among several alternative products available to them. The GPL model specification was designed so that all choices for the various insurance products are treated equally without assigning ranks. Further, the model estimation accommodates all choices to be estimated *simultaneously*, allowing every combination of the explanatory variables to be taken into consideration concurrently.

This article is based on a forthcoming ERS report and completes *Agricultural Outlook's* 1999 series on risk management.

Risk Management

Insurance, in Short

Insurance contracts can be categorized into two types of insurance products: standard yield-based crop insurance and revenue insurance products (AO April 1999). Yield insurance products available in 1997 include *Multiple Peril Crop Insurance (MPCI)* and *Group Risk Plan (GRP)*, while revenue insurance products include *Income Protection (IP)*, *Revenue Assurance (RA)*, and *Crop Revenue Coverage (CRC)*.

MPCI pays indemnities if yield falls below a guaranteed level—determined by a farmer’s average historical yield—but offers no price protection. MPCI provides minimum catastrophic coverage (CAT), with premiums fully subsidized by the government, and optional higher (or “buy-up”) levels of coverage with partially subsidized premiums.

GRP is tied to county yield rather than to individual farm yield. GRP policies pay indemnities when the county average yield drops below a threshold or guaranteed level, regardless of yield of the individual farmer. GRP buyers can insure up to 90 percent of the expected county yield at up to 150 percent of the expected price.

IP, RA, and CRC protect against lost revenue caused by low yields, low prices, or a combination of both. **IP** and **RA** protect farmers against reductions in gross income when either

prices or yields decrease during the crop year from early-season expectations. Indemnity amounts are determined by individual farm yields and harvest-time futures prices. **IP** offers a single insurance contract per commodity enterprise for the farm per county—e.g., within a county, **IP** coverage combines all corn fields which a farmer owns or from which at least a share of corn crop earnings is due. **RA**—available only in selected counties and for selected crops around the nation—allows both basic and an optional field-specific coverage (multiple insurance contracts based on ownership, farming practices, and section of the farm’s acreage).

CRC with replacement-coverage protection (RCP) provides partial protection against both yield and price shortfalls, paying an indemnity if a producer’s gross revenue falls below a predetermined guarantee level. Since **CRC** uses the higher of the planting-time price for the harvest futures contract or the actual futures contract quote at harvest in setting the guarantee, the producer’s revenue guarantee may actually increase over the season because **CRC** with RCP allows producers to purchase “replacement” bushels if yields are low and prices increase during the season. Recently, farmers in Iowa were offered **RA** contracts with a harvest price option that is very similar to **CRC** except that it imposes no limits on price increases at harvest-time.

information on coverage under four insurance plans: MPCI, RA, and CRC at coverage levels of 50 through 75 percent, and GRP at up to 90 percent. **IP** was not included in the analysis for lack of sufficient data; only 50 **IP** corn and soybeans policies were sold in Iowa in 1997. **GRIP** and **AGR** did not exist in 1997.

To analyze demand for crop insurance, ERS developed a model based on three explanatory factors that influence a farm operator’s decision to buy an insurance contract (type of product and extent of coverage):

- **Risk level** measures the producer’s level of yield or revenue risk. Yield risk—based on 10 years of yield records—is calculated as the probability of yield falling below the insurance product’s guaranteed level. Similarly, revenue risk—based on 10 years of yield records and corresponding average marketing-year prices—is calculated as the probability of revenue falling below the guaranteed level. The probability measure is based on both the mean and variance of yield or revenue

—an indicator of volatility for an individual farm.

- **Level of income** or **size of operation** is an indication of the amount of revenue at risk, along with the operator’s ability to pay for insurance or to self-insure against loss. Level of income is defined as the cumulative sum of savings over the past 10 years, using gross revenue and an assumed savings rate of 10 percent. This variable is directly proportional to the size of operation.
- **Cost of insurance**, captured by premium per dollar of liability (maximum potential indemnity or value of the insurance contract if the producer loses an entire crop), is total premium (including subsidy) divided by total liability.

These three factors are categorized into three ranges—low, medium, and high. The model then determines how these factors influence the choice of alternative yield and revenue insurance products.

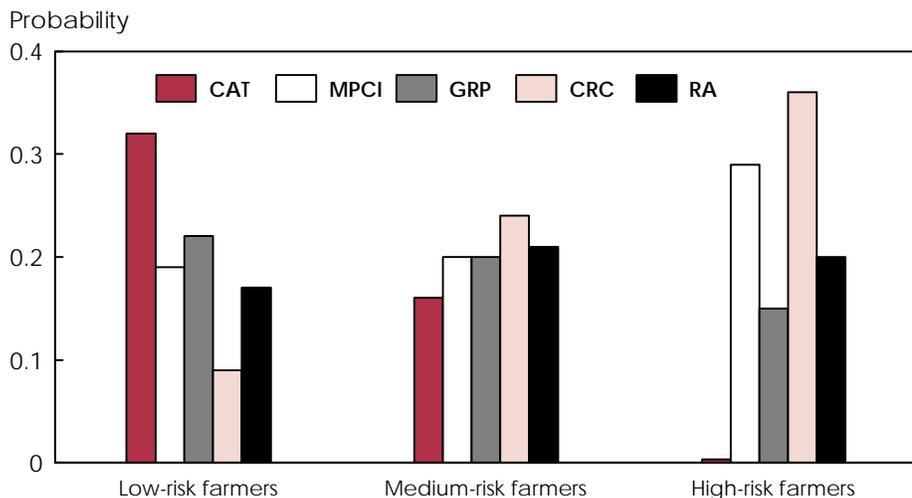
The results reveal a strong relationship between *risk level* and choice of insurance contract. Farm operators with a higher

risk of yield or revenue falling below the guaranteed level are more likely than low-risk farmers to have chosen higher coverage contracts. High-risk farmers, compared with low-risk farmers, are more likely to prefer revenue insurance (**CRC** and **RA**) over yield insurance (**MPCI**). If given a choice between only **GRP** and **MPCI**, high-risk farmers are more likely to prefer **MPCI**, which is based on individual yield history rather than county average yield.

Another way to see how risk and other factors relate to product choice is to calculate odds ratios—the odds of choosing one insurance product versus another. Comparing the odds of choosing **CRC**, **RA**, and **GRP** relative to **MPCI** for farmers with different risk levels indicates that high-risk farmers are nearly twice as likely as low-risk farmers to choose **CRC** or **RA** over **MPCI**. In general, analysis of the odds ratios indicates that high-risk farmers prefer revenue insurance while low-risk farmers prefer yield insurance.

The link between risk level and choice of insurance product was also explored by calculating the probability of choosing a

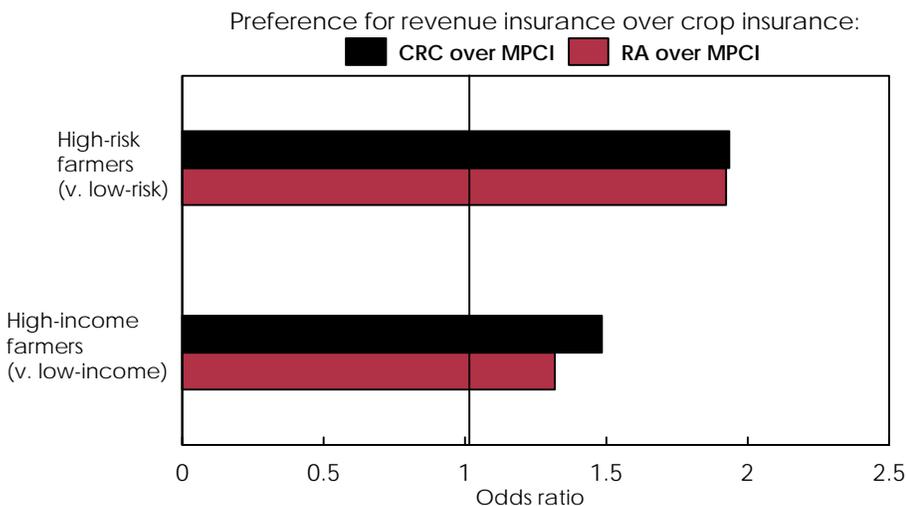
Risk Level Affects Choice of Insurance Product



Probability indicates the likelihood of farmers choosing a particular insurance product. For example, out of 100 low-risk farmers, 32 are likely to choose CAT and another 19 to choose MPCI above the CAT level. Crop-yield insurance: CAT = Catastrophic (minimum) crop-yield coverage; MPCI = Multi-peril crop insurance above the CAT level; GRP = Group risk protection. Revenue insurance: CRC = Crop revenue coverage; RA = Revenue assurance.

Economic Research Service, USDA

Farmers' Level of Risk and Income Affects Likelihood of Choosing Revenue Insurance Over Crop Insurance



Odds ratio = Probability of high-income—or high-risk—farmers choosing CRC or RA over MPCI, divided by probability of low-income—or low-risk—farmers choosing CRC or RA over MPCI. When odds ratio equals 1, probabilities (numerator and denominator) are the same. CRC=Crop revenue coverage; RA=Revenue assurance; MPCI=Multi-peril crop insurance.

Economic Research Service, USDA

specific insurance product given the farmers' risk level. The computed probabilities further strengthen the findings that high-risk farmers are more likely to choose

revenue insurance contracts (CRC or RA), while low-risk farmers are more likely to choose yield contracts (GRP, MPCI, or CAT). High-risk farmers, who have a

greater expectation of collecting indemnities, select contracts that would provide greater indemnities in the event of loss and are apparently willing to pay a higher premium to obtain those contracts.

Level of income also influences the type of insurance product a farmer purchases, as well as level of coverage. The results imply that, within the same risk class, high-income farmers are more likely to prefer revenue insurance over yield insurance. For example, the odds of choosing CRC over MPCI by high-income farmers relative to low-income farmers is 1.5, indicating that, within the same risk category, high-income farmers are 1.5 times as likely as low-income farmers to choose CRC over MPCI. Higher income farmers showed a preference for greater coverage, while lower income farmers showed a preference for lower coverage levels, contrary to the initial hypothesis that high-income farmers who could afford to self-insure against some risk loss would purchase less insurance.

Results also indicate that cost of insurance affects the decision to buy and the choice of insurance contract (regardless of risk class or income level), which underscores the importance of premium subsidies. Under the current insurance program, nearly 40 percent of producer premiums on "buy-up" coverage are subsidized. Since the subsidy is a large part of the premium, changes in Federal subsidies are likely to significantly affect the extent of farmers' use of crop insurance.

Study results suggest that by incorporating risk and other characteristics associated with farmers who buy different contracts, it may be possible to structure insurance rates to more closely reflect farmers' risk profiles. Even though the analysis is limited to Iowa corn and soybean producers, the findings provide useful insights into preferences of farmers at various risk levels in choosing among alternative insurance contracts, and the substitutability among contracts, and may facilitate making the agricultural insurance industry more self-sustaining. **AO**

Shiva S. Makki (202) 694-5316 and Agapi Somwaru (202) 694-5295
smakki@econ.ag.gov
agapi@econ.ag.gov